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ANALYSIS OF RCRA CLOSURE

FOR

GROUT VAULTS 102, 103, 104, AND 105

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ANALYSIS OF RCRA CLOSURE FOR GROUT VAULTS 102, 103, 104, AND 105

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Acronyms and Abbreviations

ALARA	As Low As Reasonably Achievable
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy, Washington, D.C.
DMF	Dry Materials Facility
DST	Double-Shell Tank
Ecology	State of Washington Department of Ecology
ECN	Engineering Change Notice
EPA	U.S. Environmental Protection Agency
GDF	Grout Disposal Facility
GPF	Grout Processing Facility
GTF	Grout Treatment Facility
HDPE	High Density Polyethylene
LDCRS	Leachate Detection/Collection and Removal System
LLW	Low-Level Waste
Part B	Grout Treatment Facility Dangerous Waste Permit Application
RCRA	Resource Conservation and Recovery Act
RL	U.S. Department of Energy, Richland Field Office
WAC	Washington (State of) Administrative Code
WHC	Westinghouse Hanford Company

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1. INTRODUCTION

The U.S. Department of Energy Richland Field Office (RL) has issued Order 5820.2A, "Radioactive Waste Management," (RL, 1990) which requires that a comprehensive closure plan be developed before initiation of operations at a new low-level waste (LLW) disposal facility. The closure plan (Chapter 11 of the "Grout Treatment Facility Dangerous Waste Permit Application" [(Part B) (RL, 1991a)] meets this requirement for the disposal of liquid low-level radioactive double-shell tank (DST) waste. The DST waste will be mixed with cementitious materials to form a grout, which will be pumped into an underground vault where it will cure and harden into a monolith. This action constitutes treatment and final disposal of this waste.

This document is an analysis of Resource Conservation and Recovery Act (RCRA) and the Part B permit application requirements for closure, for grout vaults 102, 103, 104, and 105. This analysis identifies and lists the requirements, activities, and documents necessary for closing the vaults. This document is not a requirements document and should be used as a guide. Changes to the Part B or to actual closing procedures do not necessarily require an analogous change to the analysis. In the chance that there is a difference between this document and the Part B, the Part B will rule.

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Disposal of the grouted DST waste on the Hanford Site will not have a significant effect on the quality of the environment and the calculated impacts will not exceed the regulatory limits set by the State of Washington Department of Ecology (Ecology), the U.S. Department of Energy (DOE).

The Hanford Site, due to its arid environment, is ideally suited for the shallow land burial of mixed waste (low-level radioactive waste per DOE criteria plus dangerous waste per criteria set by the State of Washington, Department of Ecology). Depth of the soil cover, Hanford Site environment aridity, high-evapotranspiration potential, and very limited (if any) amount of recharge attributable to a very reduced amount of naturally occurring precipitation, all combine to minimize, if not eliminate, liquid migration that might mobilize contaminants and cause their movement toward the unconfined aquifer. Additionally, experience gained since 1978 stabilization, shows very little maintenance is required following the successful establishment of a vegetative cover.

1.1. HANFORD SITE DESCRIPTION

The Hanford Site is an approximately 560-mi^2 tract of semiarid land owned by the U.S. Government and operated by the U.S. Department of Energy, DOE Richland Field Office. Westinghouse Hanford Company is a major contractor to the U.S. Department of Energy, DOE Richland Field Office and serves as co-operator of the Grout Treatment Facility, the treatment, storage, and disposal unit. The Hanford Site is located northwest of Richland, Washington along the Columbia River. The center of Richland lies approximately 3 mi from the

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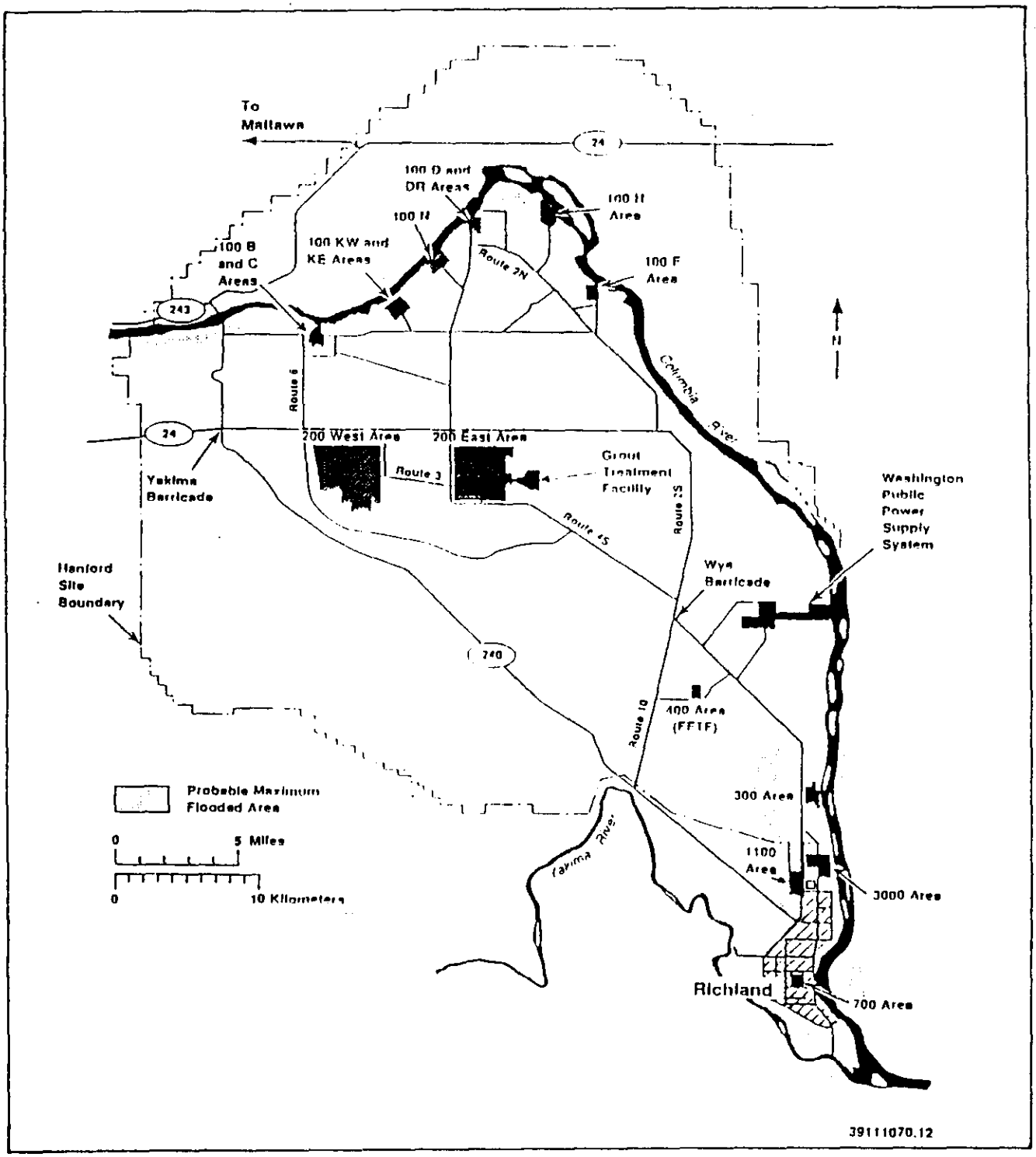

Figure 1. Hanford Site Surrounding Area

southernmost portion of the Hanford Site boundary and is the nearest population center (Figure 1).

1.2. GROUT TREATMENT FACILITY

The Grout Treatment Facility (GTF) is located in the 200 East Area and is comprised of four separate components: the Dry Materials Facility (DMF), the AP Tank Farm, the Grout Processing Facility (GPF), and the Grout Disposal Facility (GDF). Each of these are described in the following paragraphs. They are shown in Figure 2.

1.2.1. Dry Materials Facility

The DMF consists of the process equipment necessary to receive dry materials by railcar or truck, store the dry materials in the four dedicated bins, weigh and transfer the components, blend the individual components together, store the blended materials in the fifth bin, and load it into trucks for transport to the GPF. The dry materials to be stored may be fly ash, Portland cement, blast furnace slag, ground limestone, attapulgite clay, or pottery clay. The composition of the final blend may vary from waste tank to waste tank, based on waste constituents and the formulation determined for that waste.

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1.2.2. The AP Tank Farm

The liquid waste feed system consists of the Waste Feed Tanks 241-AP-102 and 241-AP-104, waste feed pumps and associated jumpers and valves, the waste feed pipe, and the control system.

The Waste Feed Tanks 241-AP-102 and 104 have a capacity of 4,126,000 L (1,090,000 gal) each. They are DSTs, located in the 200 East Area AP Tank Farm. The tanks serve as batch collection tanks and sample points for waste solutions fed to the grout mixer at the GPF.

1.2.3. The Grout Processing Facility

The treatment process performed in the GPF mixes the liquid waste with a blend of dry cementitious materials to form a slurry. The grout slurry is then pumped into a disposal vault where it cures to form a solid and stable waste form. Placement of this waste into the vault is considered a permanent disposal action and there is no intent to retrieve the waste at a future date.

The GPF will mix approximately 3,785 m^3 (1,000,000 gal) of liquid waste with the predetermined quantity of dry blend material which will result in 5,300 m^3 (1,400,000 gal) of grouted waste. The grouted waste will be pumped to a near-surface disposal vault for solidification into a monolithic form.

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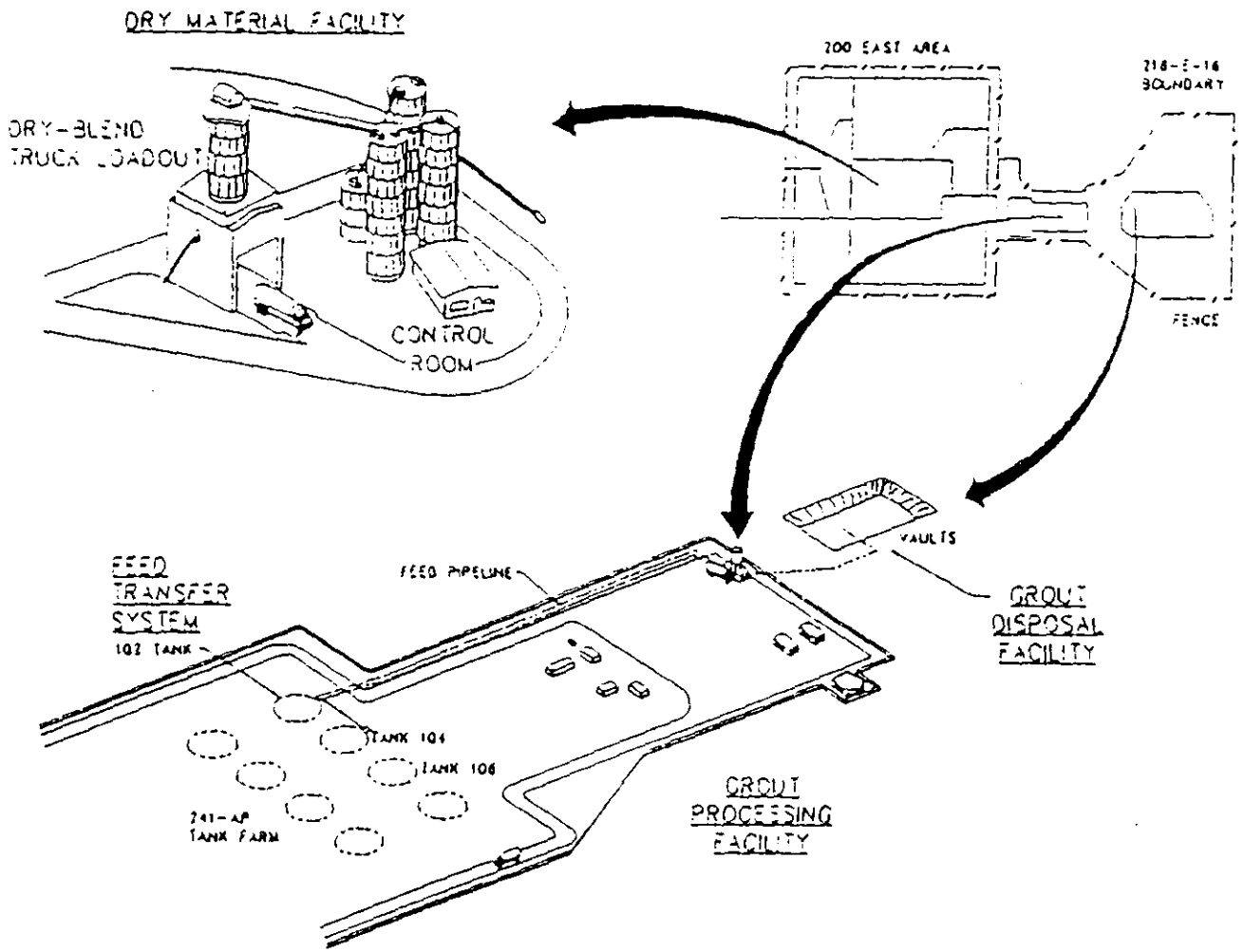
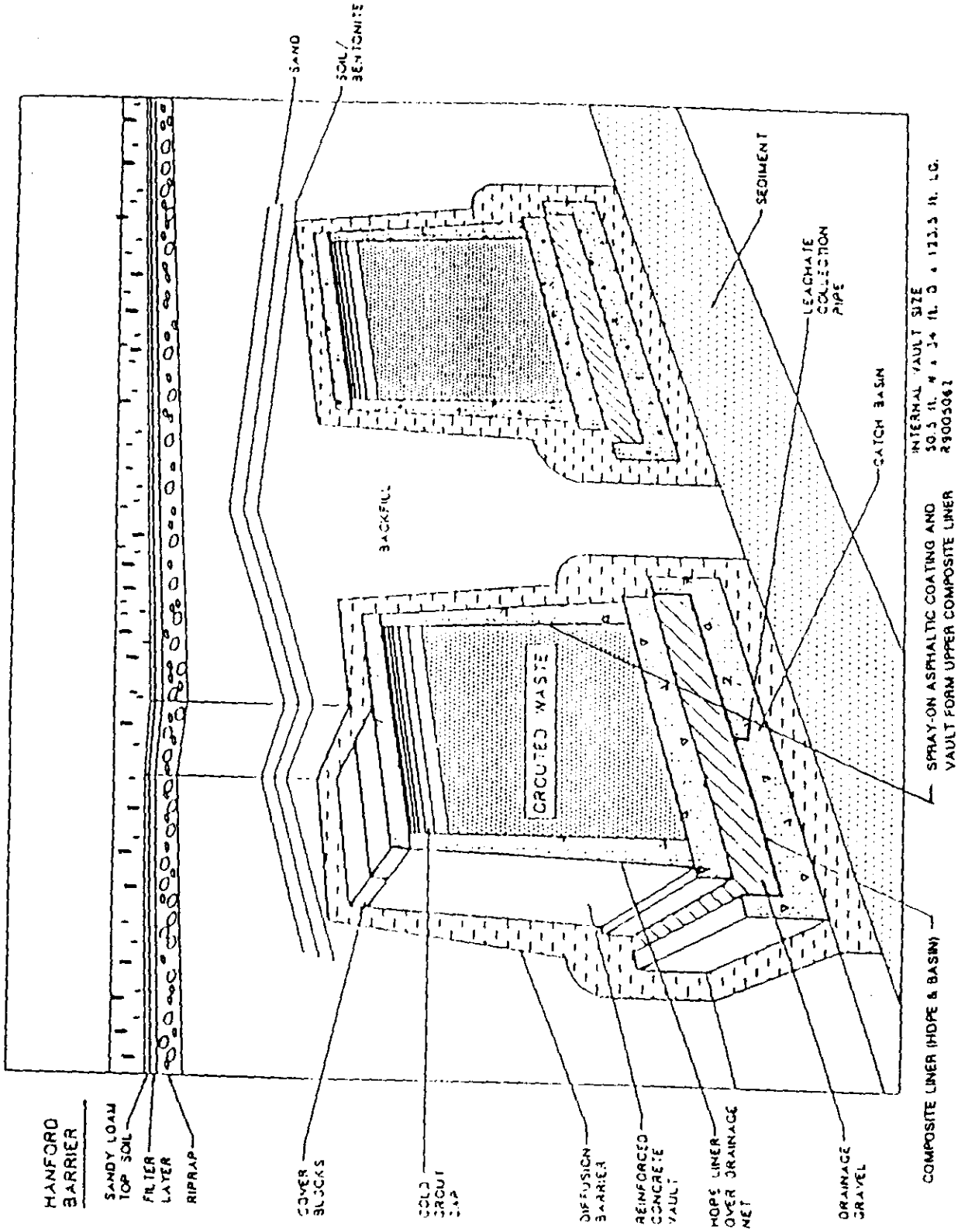


Figure 2. Grout Treatment Facility

Figure 3. Grout Disposal Facility - Closed Vault Pair



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1.2.4. Grout Disposal Facility

The near-surface disposal vault (Figure 3) is sized to hold approximately 5,300 m^3 (1,400,000 gal) of grouted waste plus 760 m^3 (200,000 gal) of cold cap grout. It is rectangular in shape [inside dimensions are 37.64 m (123 ft 6 in.) long, 15.39 m (50 ft 6 in.) wide, and 10.36 m (34 ft) deep] and constructed of cast-in-place reinforced concrete. Wall thickness ranges from 12 in. at the top to 42 in. at the bottom and is designed to withstand both the surcharge loading of the earth-backfill and the hydrostatic loading from the grout slurry.

A diffusion barrier is placed over, and around the vault, and extending under the concrete catch basin to provide a continuous (cocoon-like) barrier. The barrier shall be a minimum of 1.016 m (40 in.) thick. The asphaltic cement concrete barrier shall contain a maximum of 4 volume percent voids. The barrier is not a mandatory RCRA cover design component but is installed to achieve long-term performance. The material is installed during vault construction.

The concrete vault floor and walls serve as the foundation for the liner system. The upper liner is a composite of the vault walls/floor with the sprayed on coating. The composite liner under the vault, is the catch basin with a 60 mil high density polyethylene (HDPE) sheet. The catch basin, underneath the vault floor, is sloped so as to drain to the leachate collection sump. The vault floor is level (end-to-end and side-to-side).

2. SCOPE

This analysis is intended to identify those items necessary to close the first four grout vaults in accordance with the intent of Chapter 11 of the Part B. This analysis further lists: (1) the requirements to be followed, (2) documents to be generated, and (3) the activities which must take place in order to close grout vaults 102, 103, 104, and 105. This document will also describe the regulatory cover (RCRA) and the Hanford Barrier (presently undergoing development).

3. VAULTS CLOSURE

Closure will involve numerous activities, several organizations, and compliance with a large variety of regulations and requirements. All of the activities must be performed in strict accordance with the requirements of Part B and per drawings H-2-77589, sheets 1 and 2.

This section describes:

- 3.1) **Regulations** - the guiding regulatory documents for closure
- 3.2) **Closure Activities** - those functional steps necessary to execute closure
- 3.3) **Documentation of Closure** - those records necessary to demonstrate adequacy of closure

3.1. REGULATIONS

The following documents (with some explanatory comments) contain the requirements to be implemented:

The RCRA hazardous waste program is administered by the U.S. Environmental Protection Agency (EPA). The first set of implementing regulations were issued in May of 1980. This act and subsequent amendments form the basis of the State of Washington's Administrative Code, for Ecology's regulations with respect to solid waste.

- "Resource Conservation and Recovery Act of 1976," as amended, Public Law 94-580, 90 Stat. 2795, 42 USC 6901 et seq. (RCRA, 1976)
- Code of Federal Regulations (40CFR), Part 264 Closure and Post-Closure Subpart G (EPA, 1990)
- Washington Administrative Code (WAC), 173-303-610, 173-303-665 (Ecology, 1989)
- "Liners and Leak Detection Systems for Hazardous Waste Land Disposal Units," Federal Register (57 FR 3462) (EPA, 1992)
- Design and Construction of Covers for Solid Waste Landfills, EPA-600/2-79/165 (EPA, 1979)
- Settlement and Cover Subsidence of Hazardous Waste Landfills, EPA/600/2-85/035m (EPA, 1985)
- Test Methods for Evaluating Solid Waste-Physical/Chemical Methods, SW-846 (EPA, 1982)
- Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim Final Guidance, EPA-530/SE-89/026 (EPA, 1989)

The DOE (both Headquarters and RL specific) have developed "Orders" designed to deal with the management of both solid waste, radioactive waste, and mixed waste as it pertains to the DOE in general or for specific sites.

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- "Radioactive Waste Management," DOE-RL Order 5820.2A (RL, 1990)
- "Environmental Protection, Safety, and Health Protection; Program for RL," DOE Order 5480.1 (RL, 1982b)
- "Radiation Protection for Occupational Workers," DOE Order 5480.11 (RL, 1982a)
- "Environment, Safety, and Health Program for DOE Operations," DOE Order 5480.1B (DOE, 1986)
- "Industrial Hygiene Program," DOE Order 5480.10 (DOE, 1990)
- "Decontamination and Decommissioning," DOE Order 6430.1A (DOE, 1989)
- "The Hanford Site Radiological Control Manual," (HSRCM-1) (RL 1992)
- Architectural-Civil Standards/Design-Guide Book (Hanford Plant Standards) (RL 1991b)

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State and Federal law requires that individuals/organizations that do or intend to generate, store, treat, transport, or dispose of solid waste submit an application for a permit to do so. At the Hanford Site each organization involved in waste activities must develop their own permit application. All of the separate applications will be appended into the Hanford Facility Permit. This document has been written in response to RCRA.

- "Grout Treatment Facility Dangerous Waste Permit Application, Part B, Rev. 2" (RL, 1991a)

The manuals listed below are some that have been developed by the Westinghouse Hanford Company. These specific manuals apply all or in part to closure of the vaults.

- Environmental Investigations and Site Characterization Manual, WHC-CM-7-7 (WHC, 1989)
- ALARA Program Manual, WHC-CM-4-11 (WHC, 1990)
- Radiation Protection Manual, WHC-CM-4-10 (WHC, 1991)
- Environmental Compliance Manual, WHC-CM-7-5 (WHC, 1988)
- Grout for Closure of the Demonstration Vault at the US DOE Hanford Facility, (SL-92-21) (Corps, 1992)

- Quality Assurance Manual, WHC-CM-4-2 (WHC, 1988)
- Industrial Safety Manual, WHC-CM-4-3 (WHC, 1992)

3.2. CLOSURE ACTIVITIES

Closure activities will commence after the completion of the following activities:

- Placement of the grouted waste (this will bring the level of the waste form within approximately 4 ft of the cover blocks)
- Excess liquid remaining on the surface of the grout (after specified cure period) has been removed
- Coring of the grout (if required) has been completed, cores analyzed and the vault approved for closing

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The closure activities will generally proceed in a stepwise manner. However, there are some activities which may take place concurrently with others. Workplans will normally detail the proper sequence of most activities and engineering plans and specifications will quite often describe others. The principle steps in closing the vaults are as follows:

- Place cold cap (two or more lifts)
- The equipment, including the active exhauster(s), will be relocated after first lift of cold cap is in place
- Fill and seal risers
- Fill pits
- Remove (and prepare for burial) the excess liquid line and the grout slurry line
- Take soil samples from the pipeline trenches for analysis and transfer to designated laboratory

Since the vaults are to be closed in pairs, the next series of closure activities will be on hold until the second vault in the pair is ready for the same steps as listed above. Once the steps above have been repeated for the second vault in a pair, the next sequence of activities may be initiated as follows:

- Provisions for long-term leachate monitoring/removal will be enacted
- Placement of the RCRA Cover

3.3. DOCUMENTATION OF CLOSURE

In order to provide verification that all required activities have been accomplished in compliance with the intent of the, Part B, the activities must be documented. The documents must be traceable to the specific activity. Documents/records must be maintained with respect to all activities affecting safety and or quality. The documents/records will be generated and maintained in accordance with the Quality Assurance Manual, (WHC, 1988) or equivalent (when there is a change in RL's contractor). Certain types of documents such as audits, surveillances, nonconformance reports, and corrective action reports will be generated as appropriate for all items/activities. The majority of the documents are those that are required by WHC, there are specific ones that are required by RCRA. In some cases copies of the documents will be required by both WHC and RCRA. The documents required under RCRA will be provided to Ecology and the EPA. All documents unless otherwise noted are required by WHC. The sections which follow list the activities with the major documentation to provide the necessary traceability.

3.3.1. Cold Cap Placement Documentation

WHC Required

- Work Plan
- Contamination Control Plan
- Radiation Work Permit
- Radiation Work Procedures
- Cold Cap Placement Procedures
- Cold Cap Compatibility Test Data
- Job Control System Records
- Sign-Off Completed Work (J-8)

RCRA Required

- Procurement Documents (Cold Cap Grout)
- Quality Control Sample and Test Plan (plastic and cured cold cap)
- Concrete Mixer Trucks' Trip Tickets for all Cold Cap Grout Placed
- Sample and Test Records (cold cap grout)
- Qualification/Training Records (test/inspection personnel)

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3.3.2. Fill and Seal Risers and Pits

WHC Required

- Work Plan
- Contamination Control Plan
- Radiation Work Permit
- Radiation Work Procedures
- Closure Procedures
- Job Control System Records
- Sign-Off completed Work (J-8)

RCRA Required

- Procurement Documents (Asphalt Cement)
- Design Drawings and Appropriate Engineering Change Notices (ECN)
- Delivery Truck Trip Tickets
- Sample and Test Records (if generated)
- Qualification/Training Records

3.3.3. Remove (and/or Prepare for Burial) the Excess Liquid Line and the Grout Slurry Line

WHC Required

- Work Plan
- Radiation Work Plan
- Radiation Work Permit
- Work Procedures
- Job Control System Sheets
- Sign-Off completed Work (J-8)

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RCRA Required

- Documents/Records required for packaging and on-site shipping of Low-Level Mixed Waste per, Hanford Site Solid Waste Acceptance Criteria Manual, (WHC, 1991)

3.3.4. Take Soil Samples from Pipeline Trenches for Analysis

WHC Required

- Work Plan
- Radiation Work Plan
- Radiation Work Permit
- Work Procedures

RCRA Required

- Sampling Protocol per RCRA
- Chain of Custody Documents
- Report on Background Soil Samples
- Analysis Reports on Pipeline Trench Samples
- Qualification/Training Records

3.3.5. Placement of RCRA Cover

WHC Required

- Procurement Documents/Request for Proposal
- Bid Selection
- Contract Award
- Engineer's Diary
- Daily Progress Reports
- Construction Acceptance Reports

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RCRA Required

- Engineering Plans, Specifications, Drawings, and all relevant ECNs
- As-Built Drawings
- Quality Control Tests, e.g. sieve analysis, compaction tests, etc.
- Survey Reports
- Notices in Deed
- Notices to Local Land Authority
- Repair/Maintenance Reports
- Liquid Level in the LDCRS Monitoring Reports

3.3.6. Placement of Hanford Barrier

WHC Required

- Procurement Documents/Request for Proposal
- Bid Selection
- Contract Award
- Engineer's Diary
- Daily Progress Reports
- Construction Acceptance Reports
- Notices to Local Land Authority

RCRA Required

- Engineering Plans, Specifications, Drawings, and all relevant ECNs
- Quality Control Tests, e.g., sieve analysis, compaction tests, etc.
- As-Built drawings
- Survey Reports
- Notices in Deed
- Certifications of Completion of Postclosure Care

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- Owner/Operator Postclosure Certification
- Professional Engineer Postclosure Certification
- Five Year Well Condition Evaluation Report
- Repair/Maintenance Reports

4. RCRA COVER FOR A VAULT PAIR

The grout vaults will be closed in pairs within two years after the placement of the cold cap grout. They are designed to facilitate sequenced construction and to minimize land use and cost. A cross section of the closure cover over a pair of grout vaults is shown in Figure 3. The closure cover installation process will consist of the following tasks.

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Gravel will be added to obtain a 10 percent slope. Next, a geotextile fabric will be placed over the gravel layer. A 0.3 m (1 ft) thick drainage sand layer will be placed over the geotextile fabric. The sand will drain any water away from the grout vaults that could penetrate the upper cover components. Grade stakes are used to ensure that thicknesses and overall slopes are maintained.

Next, a geotextile fabric will be placed over the sand layer. This fabric layer will be used to prevent plugging of the porous sand layer by fine soil particles sifting downward from subsequent layers of the cover. Overlapping and field connections of individual sheets will be accomplished according to the manufacturer's recommendations and the installation specifications.

The next task will be the installation of a water infiltration barrier comprising a mixture of selected excavation materials and imported bentonite clay (low-permeability layer) over the geotextile fabric. These materials will be placed in lifts not exceeding 15.24 cm (6 in.) using dump trucks, front-end loaders and/or scrapers, and standard road graders according to the installation specifications. These materials will be mixed thoroughly before compacting to achieve a saturated hydraulic conductivity of not more than 1 E-7 cm per second (3.3 E-9 ft per second). The water barrier (sandy silt with bentonite) will be nominally 0.6 m (2 ft) thick and will be located wholly below the average depth of frost penetration.

The freeze/thaw and dry/soak phenomena will not cause a stability problem. Subsurface soil temperatures have been recorded at the Hanford Meteorological Station since 1952. The lowest temperature recorded at 91.44 cm (36 in.) below the surface was 0°C (32°F), which occurred once over the monitoring period (Stone et al., 1983). Therefore, the normal zone of frost penetration does not exceed 0.9 m (3 ft) below grade. Construction quality

assurance and quality control measures will be conducted throughout to ensure that the appropriate slopes are maintained and that the desired compaction is attained.

A high density polyethylene (HDPE) geomembrane will be placed above the low-permeability native sandy silt bentonite layer, and the HDPE geomembrane will be placed according to the manufacturer's specifications. Another 0.3 m (1 ft) layer of drainage sand will be placed above the geomembrane; this layer also will be covered with geotextile fabric, which will prevent the downward sifting of the overlying soil. The area will be backfilled with topsoil to final grade using imported soil that meets required soil characteristics. A detailed site characterization effort to establish the quality and quantity of topsoil, based on water retention characteristics via particle size analysis, was completed (Last et al., 1987). Dump trucks, front-end loaders, scrapers, and road graders can be used for this operation. The closure area will be graded such that the surface is sloped to drain.

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Next, the ground will be prepared for planting, fertilized, seeded, and mulched. These activities will follow standard dry-land farming practices using equipment available onsite. Fertilizer will be applied at a rate of 140 kg per hectare (125 lb per acre) available nitrogen. Seeding will involve a variety of native and/or adapted perennial grasses seeded at a total rate of 17 kg per hectare (15 lb per acre). The grasses will be drill seeded. The wheatgrasses will be planted in the fall whenever practicable. If, because of scheduling, cover installation requires a spring planting, an annual cereal ryegrass will be applied to quickly stabilize the surface followed by planting of perennial wheatgrasses in the fall.

Following the seeding, the entire area undergoing closure will be mulched with straw at a rate of approximately 2,250 kg per hectare (1 ton per acre). Mulching will be performed with a powered mulcher designed to provide uniform application. The straw will be anchored in place with a crimper to provide initial surface soil protection pending the emergence and establishment of the grasses.

5. THE HANFORD BARRIER

The Hanford Barrier development program is ongoing at the Hanford Site with the objective to develop, test, and verify a long-term barrier or cover design to minimize radionuclide migration (Adams and Wing, 1987). A multilayered conceptual cover design has been completed. Field and laboratory tests and one- and two-dimensional unsaturated flow simulations are ongoing to optimize and verify the design. Once a long-term cover design has been evaluated and verified, a comparative analysis will be performed with the closure cover design submitted herein. The analysis will evaluate the additional cover design and modifications required to enhance the closure

cover design to provide isolation of radionuclide waste constituents beyond the postclosure monitoring period.

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